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Author(s)	Saito, Tomomi; Nakajima, Kiyonori; Konishi, Kooichi
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**First Zœa of a Rare Deep-sea Shrimp *Vexillipar repandum* Chace,
1988 (Crustacea, Decapoda, Caridea, Alpheidae), with Special
Reference to Larval Characters of the Family**

TOMOMI SAITO¹⁾, KIYONORI NAKAJIMA¹⁾ and KOOICHI KONISHI²⁾

¹⁾ Port of Nagoya Public Aquarium, Minato-ku, Nagoya 455–0033, Japan

²⁾ National Research Institute of Aquaculture, Nansei, Mie 516–0193, Japan

Abstract First zœa of a rare alpheid shrimp *Vexillipar repandum* Chace, associated with a deep-sea hexactinellid sponge, is described and illustrated based on laboratory-hatched material. The general morphology of the first zœa of *V. repandum* is similar to those of the previously-known examples of *Alpheus*. A diagrammatic key for identification of the family among caridean zœas is proposed.

Key words: first zœa, key, taxonomy, description, Alpheidae, *Vexillipar*

Introduction

Japanese alpheid fauna includes more than 110 species, approximately 20% of whole caridean shrimps (Miya, 1995; Hayashi, 1995b), but larval stages of the family have been documented only on two species (see Table 1). Miyazaki (1937) gave a short description of the first zœa of *Alpheus brevicristatus* De Haan. Yang and Kim (1996) described early zœal development of *A. euphrosyne richardsoni* Yaldwyn under laboratory conditions. Kurata (1965) reported late zœal stages of unidentified *Alpheus* species from field plankton samples, although the specific identification was not made. No other larval stages have been given in the genera of the Alpheidae of Japan and the adjacent waters. Recently, we obtained a few larval specimens of a rare deep-sea shrimp *Vexillipar repandum* Chace, which is associated with a hexactinellid sponge. The present paper describes the first zœa of *V. repandum*, and compares the diagnostic larval characters of Alpheidae with those of the other caridean families.

Materials and Methods

A pair of the shrimps, male and ovigerous female, was obtained from a spongocoel of a hexactinellid

Table 1. Larval descriptions in major caridean families in Japan.

Family	Number of species	Larval description	Percentage described
Palaemonidae	101	12	11.9
Alpheidae	69	2	2.9
Hippolytidae	62	10	16.1
Crangonidae	29	7	24.1
Pandalidae	27	8	29.6
Oplophoridae	14	1	7.1
Others	51	—	—

sponge, *Euplectella oweni* Herklots and Marshall, collected from a depth of 300 m off Makurazaki (130°E, 31°N), Kagoshima Prefecture, Japan on 20th October 1993. The shrimps were kept in a tank with 2 tons of running sea water at 12°C in the Port of Nagoya Public Aquarium (PNPA). The female released zoeas on 16th December 1993, but most of the zoeas were lost through running water system of the aquarium and only two zoeas were obtained.

The larvae were fixed in 5 % buffered formalin. Dissection and measurements were made with a Nikon SMZ-10 binocular stereomicroscope. Carapace length (CL) is measured as the distance of the anterior end of eye and dorsal posterior midpoint of the carapace. The drawings are made with a drawing tube attached to an Olympus BH-2 with binocular dissecting microscope. Most of the terminology for setae follows that of Ingle (1992). Setation counts are proximal to distal. The specimens used in this study are deposited in PNPA, under accession numbers Ar 0005-0007; I0002.

Description of first zoea

Carapace (Fig. 1A): CL=0.95 and 0.96 mm in 2 specimens. Rostral spine indistinct. Eyes sessile.

Antennule (Fig. 1B): Unsegmented peduncle with a long plumose seta terminally. Outer flagellum with 3 aesthetascs and 3 simple setae.

Antenna (Fig. 1C): Protopod with a spine at mesial end. Endopod pointed distally, almost half of exopod length, with a long plumose seta and a spine at mesial end. Exopod (scaphocerite) with 8 plumose setae on mesial margin and 2 lateral plumose setae plus a short distal spine.

Mandibles (Fig. 2A): Incisor and molar processes recognized but not well-developed.

Maxillule (Fig. 2B): Reduced form. Coxal and basial endites with 2 distal naked spines, respectively. Endopod unsegmented, with 2 distal naked spines.

Maxilla (Fig. 2C): Coxal and basial endites reduced rounded form, with short plumose seta on the distal lobe of coxal endite. Endopod reduced with a plumose seta and a strong spine. Scaphognathite with 4 soft marginal plumose setae and a single posterior plumose process.

First maxilliped (Fig. 2D): Coxa and basis indistinctly segmented, with 4 hook-like spines on ventral side. Endopod indistinctly segmented with an elongate spine and 4 setae distally. Exopod unsegmented with 5 plumose long natatory setae at terminal end.

Second maxilliped (Fig. 2E): Coxa and basis unsegmented with 2 thin ventral setae. Endopod 3-segmented with a thin seta on first, a serrated spine on second, and 3 setae plus a claw-like spine on third segment. Exopod unsegmented with one subterminal and 4 terminal plumose long setae.

Third maxilliped (Fig. 2F): Coxa and basis almost as in maxilliped 2. Endopod 3-segmented with 2 simple setae on second, and a claw-like spine and 3 thin setae on third segment. Exopod 2-segmented with 2 long plumose setae on proximal, and 4 long plumose setae on distal segment terminally.

Pereopods (Fig. 2G-I): First pereopod biramous, and other legs uniramous rudiments.

Abdomen (Fig. 1A): Five somites and telson, without any spines.

Telson (Fig. 1D): Triangular, not separated from sixth abdominal somite. Posterior margin with median cleft and 7 pairs of plumose setae, outer 2 pairs plumose only on inner side, innermost seta shortest.

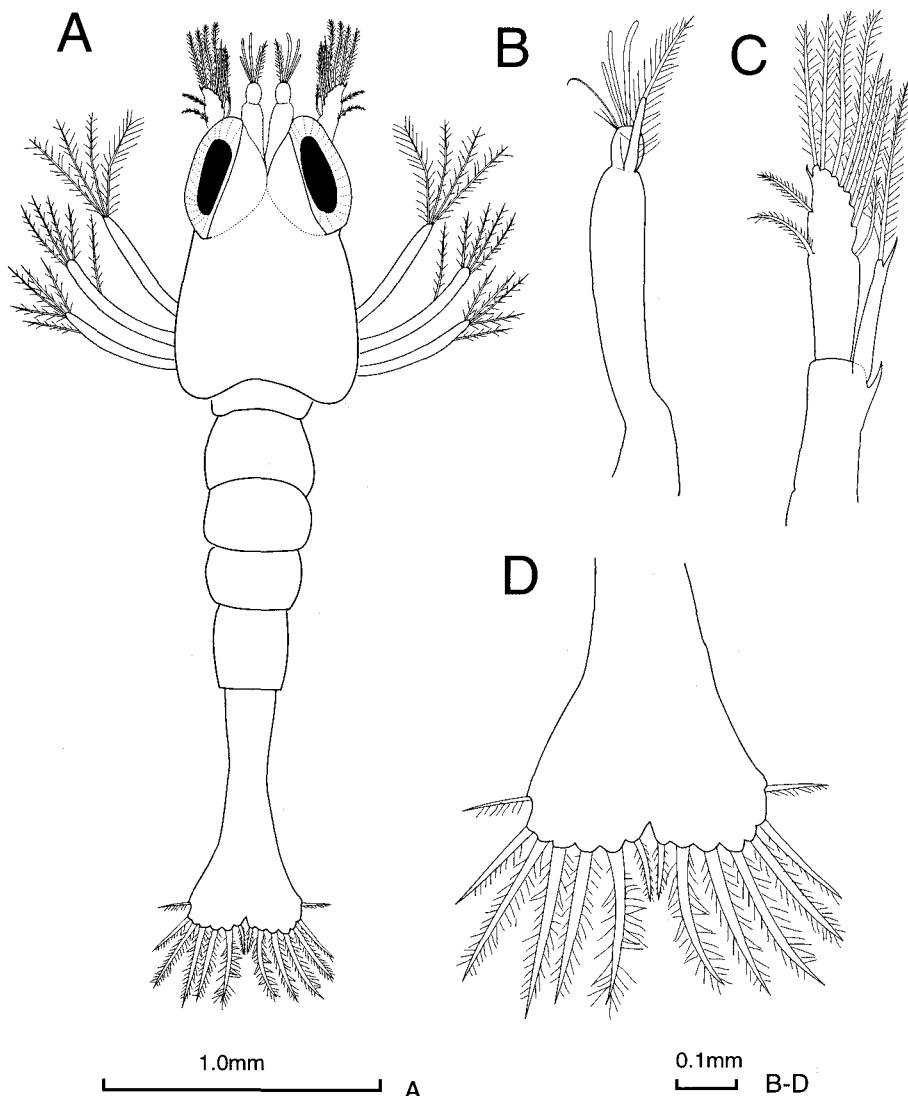


Fig. 1. *Vexillipar repandum* Chace, first zoea. A) whole animal in dorsal view; B) antennule; C) antenna; D) telson.

Discussion

The family Alpheidae consists of approximately 400 species of 32 genera in the world, and distributes mainly in the tropical and subtropical regions (Miya, 1995). These shrimps, including many commensal species, are commonly found in coral reefs and considered as the most diverse group among the caridean families. The hexactinellid sponge-associated species, *Vexillipar repandum*, was originally recorded from adjacent waters of the Philippines ranging between 296 and 875 m depth through the Albatross Expedition in 1907–1910, and perhaps the deepest known member of the Alpheidae (Chace, 1988; Hayashi, 1995a). Most of commensal alpheid species pass through direct or abbreviated development as shown in the genera *Synalpheus* and *Alpheus* (e.g., Boudillon-Casanova, 1960; Knowlton, 1973). Actually, another sponge-associated shrimp *Spongicola japonica* Kubo (Stenopodidea,

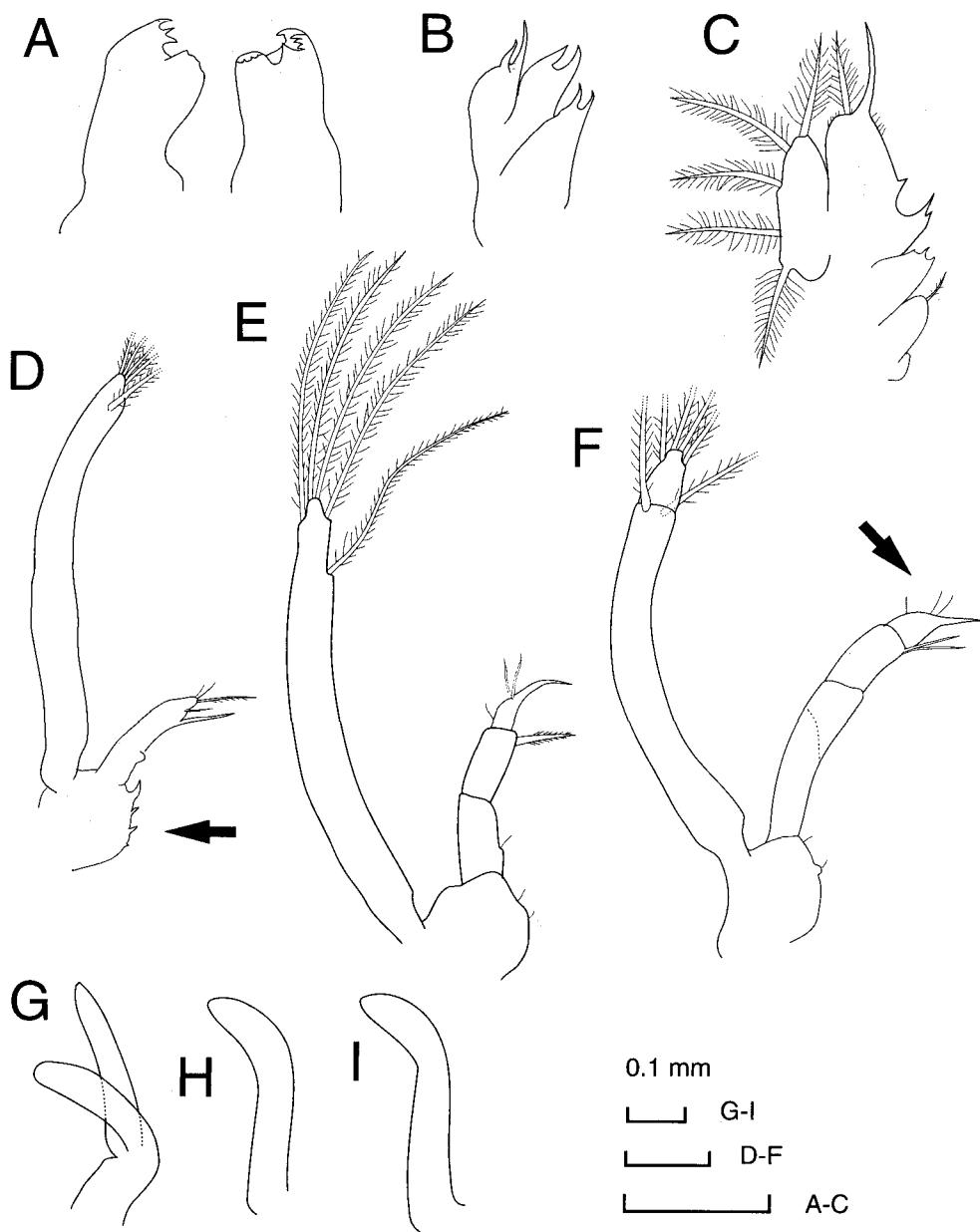


Fig. 2. *Vexillipar repandum* Chace, first zoea. A) mandibles; B) maxillule; C) maxilla; D) first maxilliped; E) second maxilliped; F) third maxilliped; G) first pereopod; H) second pereopod; I) third pereopod.

Spongicolidae), which lives in the same host with *V. repandum*, has the direct larval development (Saito and Konishi, 1999), while the present species release free swimming larvae.

Main larval characters of first zoeas in the Alpheidae from the Indo-Pacific region except for the species of which development is abbreviated or direct type are compared in

Table 2. Comparison of main larval characters in the first zoeas of the families Alpheidae and Hippolytidae.

Family	Alpheidae				Hippolytidae		
	Species	<i>Vr</i>	<i>Ab</i>	<i>As</i>	<i>Aer</i>	<i>Sg</i>	<i>Sp</i>
Mandibles:	R	?	?	?	D	D	D
Maxillule:							
endites	R	R	R	R	D	D	D
endopod	R	R	R	R	D	D	D
Maxilla:							
endites	R	R	R	R	D	D	D
endoopod	R	R	R	R	D	D	D
First maxilliped:							
basial setae	-	-	-	-	+	+	+
basial spines	+	+	+	+	-	-	-
endopod	R	R	R	R	D	D	D
Third maxilliped:							
endopod spine	+	+	+	+	-	-	-
Telson:	7+7	7+7	7+7	7+7	7+7	7+7	7+7

D: developed, R: reduced +: present, -: absent

Ab: *Alpheus brevicristatus* [Miyazaki, 1937]*As*: *Alpheus strenus* [Prasad & Tampi, 1957]*Aer*: *Alpheus euphrosyne richardsoni* [Yang & Kim, 196]*Hg*: *Heptacarpus geniculatus* [Yokoya, 1957]*Hp*: *Heptacarpus pandaloides* [Yokoya, 1957]*Fr*: *Heptacarpus rectirostris* [Yokoya, 1957]*Vr*: *Vexillipar repandum* [this study]Table 2. The general characters in the first zoeas of the family Hippolytidae which is the nearest kin of the Alpheidae in the classification of the adult are listed for comparison. The zoeas of the family Alpheidae resemble well each other: i. e., reduced mouth parts as pointed out by Gurney (1942), and specialized form of basis and endopod of maxillipeds. The general morphology of the zoea of *V. repandum* is also similar to that of shallow water species of *Alpheus*.

At present, we can not identify genera or species of the larvae of the Alpheidae obtained from the field collection, because of insufficient information on the morphology. However, the zoeas of the Alpheidae are easily distinguished from those of the other caridean families as follows:

(1) basal part of maxillipeds with spinules instead of setae (arrow), (2) a stout spine on the distal segment of endopod of third maxilliped (arrow). Figure 3 gives a diagrammatic key for the zoeas of Alpheidae.

Life history of *V. repandum* remains unknown. This species is very rare, because only two female shrimps were caught throughout 40 times of net trawlings in past five years. Improvement of culture techniques and detailed ecological observations of the adults are needed for clarification of the complete larval development.

Infraorder Caridea

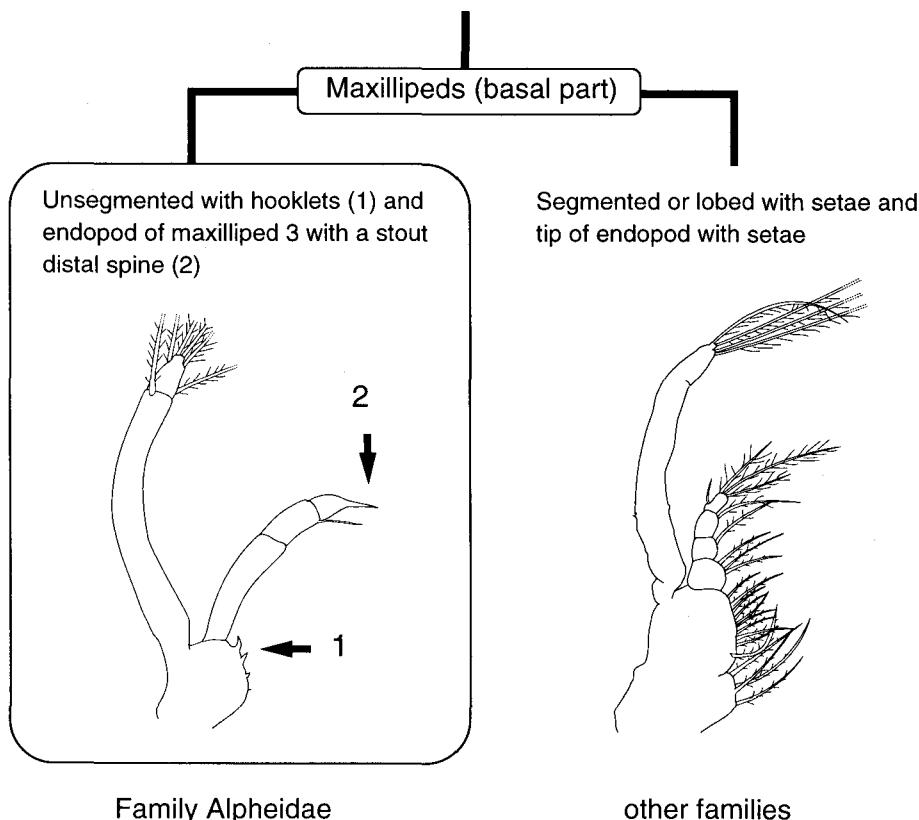


Fig. 3. Diagrammatic key to the zoeas of the family Alpheidae. Arrows indicate the main characteristics.

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